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This is a data report presenting the species and abundance of phytoplankton in the 5 lakes sampled by the National Eutrophication Survey in the State of Mississippi. Results from the calculation of several water quality indices are also included (Nygaard's Trophic State Index, Palmer's Organic Pollution Index, and species diversity and abundance indices).

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DISTRIBUTION OF PHYTOPLANKTON IN MISSISSIPPI LAKES

by

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FOREWORD

Protection of the environment requires effective regulatory actions which are based on sound technical and scientific information. This information must include the quantitative description and linking of pollutant sources, transport mechanisms, interactions, and resulting effects on man and his environment. Because of the complexities involved, assessment of specific pollutants in the environment requires a total systems approach which transcends the media of air, water, and land. The Environmental Monitoring and Support Laboratory-Las Vegas contributes to the formation and enhancement of a sound integrated monitoring data base through multidisciplinary, multimedia programs designed to:

- develop and optimize systems and strategies for monitoring pollutants and their impact on the environment
- demonstrate new monitoring systems and technologies by applying them to fulfill special monitoring needs of the Agency's operating programs

This report presents the species and abundance of phytoplankton in the 5 lakes sampled by the National Eutrophication Survey in the State of Mississippi, along with results from the calculation of several commonly used biological indices of water quality and community structure. These data can be used to biologically characterize the study lakes, and as baseline data for future investigations. This report was written for use by Federal, State, and local governmental agencies concerned with water quality analysis, monitoring, and/or regulation. Private industry and individuals similarly involved with the biological aspects of water quality will find the document useful. For further information contact the Water and Land Quality Branch, Monitoring Operations Division.

George B. Morgan
Director
Environmental Monitoring and Support Laboratory
Las Vegas

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INTRODUCTION

The collection and analysis of phytoplankton data were included in the National Eutrophication Survey in an effort to determine relationships between algal characteristics and trophic status of individual lakes.

During spring, summer, and fall of 1973, the Survey sampled 250 lakes in 17 States. Over 700 algal species and varieties were identified and enumerated from the 743 water samples examined.

This report presents the species and abundance of phytoplankton in the 5 lakes sampled in the State of Mississippi (Table 1). The Nygaard's Trophic State (Nygaard 1949), Palmer's Organic Pollution (Palmer 1969), and species diversity and abundance indices are also included.

TABLE 1. LAKES SAMPLED IN THE STATE OF MISSISSIPPI

STORET No.	Lake Name	County
2801	Arkabutla Reservoir	Desoto, Tate
2802	Enid Lake	Yalo Busha, Panola
2804	Ross Barnett Reservoir	Hinds, Madison, Rankin
2805	Sardis Lake	Panola, Lafayette
2806	Grenada Lake	Grenada, Yalo Busha

MATERIALS AND METHODS

LAKE AND SITE SELECTION

Lakes and reservoirs included in the Survey were selected through discussions with State water pollution agency personnel and U.S. Environmental Protection Agency Regional Offices (U.S. Environmental Protection Agency 1975). Screening and selection strongly emphasized lakes with actual or potential accelerated eutrophication problems. As a result, the selection was limited to lakes:

(1) impacted by one or more municipal sewage treatment plant outfalls either directly into the lake or by discharge to an inlet tributary within approximately 40 kilometers of the lake;

(2) 40 hectares or larger in size; and

(3) with a mean hydraulic retention time of at least 30 days.

Specific selection criteria were waived for some lakes of particular State interest.

Sampling sites for a lake were selected based on available information on lake morphometry, potential major sources of nutrient input, and on-site judgment of the field limnologist (U.S. Environmental Protection Agency 1975). Primary sampling sites were chosen to reflect the deepest portion of each major basin in a test lake. Where many basins were present, selection was guided by nutrient source information on hand. At each sampling site, a depth-integrated phytoplankton sample was taken. Depth-integrated samples were uniform mixtures of water from the surface to a depth of 15 feet (4.6 meters) or from the surface to the lower limit of the photic zone representing 1 percent of the incident light, whichever was greater. If the depth at the sampling site was less than 15 feet (4.6 meters), the sample was taken from just off the bottom to the surface. Normally, a lake was sampled three times in 1 year, providing information on spring, summer, and fall conditions.

SAMPLE PREPARATION

Four milliliters (ml) of Acid-Lugol's sollution (Prescott 1970) were added to each 130-ml sample from each site at the time of collection for preservation. The samples were shipped to the Environmental Monitoring and Support Laboratory, Las Vegas, Nevada, where equal volumes from each site were mixed to form two 130-ml composite samples for a given lake. One composite sample was put into storage and the other was used for the examination.

Prior to examination, the composite samples were concentrated by the settling method. Solids were allowed to settle for at least 24 hours prior to siphoning off the supernate. The volume of the removed supernate and the volume of the remaining concentrate were measured and concentrations determined. A small (8 ml) library subsample of the concentrate was then taken. The remaining concentrate was gently agitated to resuspend the plankton and poured into a capped, graduated test tube. If a preliminary examination of a sample indicated the need for a more concentrated sample, the contents of the test tube were further concentrated by repeating the settling method. Final concentrations varied from 15 to 40 times the original.

Permanent slides were prepared from concentrated samples after analysis was complete. A drop of superconcentrate from the bottom of the test tube was placed in a ring of clear Karo® Corn Syrup with phenol (a few crystals of phenol were added to each 100 ml of syrup) on a glass slide, thoroughly mixed, and topped with a coverglass. After the syrup at the edges of the coverglass had hardened, the excess was scraped away and the mount was sealed with clear fingernail polish. Permanent diatom slides were prepared by drying sample material on a coverglass, heating in a muffle furnace at 400° C for 45 minutes, and mounting in Hyrax.® Finally, the mounts were sealed with clear fingernail polish.

Backup samples, library samples, permanent sample slides, and Hyrax®-mounted diatom slides are being stored and maintained at the U.S. Environmental Protection Agency's Environmental Monitoring and Support Laboratory-Las Vegas.

EXAMINATION

The phytoplankton samples were examined with the aid of binocular compound microscopes. A preliminary examination was performed to precisely identify and list all forms encountered. The length of this examination varied depending on the complexity of the sample. An attempt was made to find and identify all of the forms present in each sample. Often forms were observed which could not be identified to species or to genus. Abbreviated descriptions were used to keep a record of these forms (e.g., lunate cell, blue-green filament, Navicula #1). Diatom slides were examined using a standard light microscope. If greater resolution was essential to accurately identify the diatoms, a phase-contrast microscope was used.

After the species list was compiled, phytoplankton were enumerated using a Neubauer Counting Chamber with a 40X objective lens and a 10X ocular lens. All forms within each field were counted. The count was continued until a minimum of 100 fields had been viewed, or until the dominant form had been observed a minimum of 100 times.

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QUALITY CONTROL

Internal quality control checks on species identifications and counts were performed on a regular basis between project phycologists at the rate of 7 percent. Although an individual had primary responsibility for analyzing a sample, taxonomic problems were discussed among the phycologists.

Additional quality control checks were performed on the Survey samples by Dr. G. W. Prescott of the University of Montana at the rate of 5 percent. Quality control checks were made on 75 percent of these samples to verify species identifications while checks were made on the remaining 25 percent of the samples to verify genus counts. Presently, the agreement between quality control checks for species identification and genus enumerations is satisfactory.

RESULTS

The Appendix summarizes all of the phytoplankton data collected from the State by the Survey. It is organized by lake, including an alphabetical phytoplankton species list with concentrations for individual species given by sampling date. Results from the application of several indices are presented (Nygaard's Trophic State, Palmer's Organic Pollution, and species diversity and abundance). Each lake has been assigned a four digit STORET number. [STORET (STOrage and RETrieval) is the U.S. Environmental Protection Agency's computer system which processes and maintains water quality data.] The first two digits of the STORET number identify the State; the last two digits identify the lake.

NYGAARD'S TROPHIC STATE INDICES

Five indices devised by Nygaard (1949) were proposed under the assumption that certain algal groups are indicative of levels of nutrient enrichment. These indices were calculated in order to aid in determining the surveyed lakes' trophic status. As a general rule, Cyanophyta, Euglenophyta, centric diatoms, and members of the Chlorococcales are found in waters that are eutrophic (rich in nutrients), while desmids and many pennate diatoms generally cannot tolerate high nutrient levels and so are found in oligotrophic waters (poor in nutrients).

In applying the indices to the Survey data, the number of taxa in each major group was determined from the species list for each sample. The ratios of these groups give numerical values which can be used as a biological index of water richness. The five indices and the ranges of values established for Danish lakes by Nygaard for each trophic state are presented in Table 2. The appropriate symbol, (E) eutrophic and (O) oligotrophic, follows each calculated value in the tables in the Appendix. A question mark (?) was entered in these tables when the calculated value was within the range of both classifications.

PALMER'S ORGANIC POLLUTION INDICES

Palmer (1969) analyzed reports from 165 authors and developed algal pollution indices for use in rating water samples with high organic pollution. Two lists of organic pollution-tolerant forms were prepared, one containing 20 genera, the other, 20 species (Tables 3 and 4). Each form was assigned a pollution index number ranging from 1 for moderately tolerant forms to 6 for extremely tolerant forms. Palmer based the index numbers on occurrence records and/or where emphasized by the authors as being especially tolerant of organic pollution.

TABLE 2. NYGAARD'S TROPHIC STATE INDICES ADAPTED FROM HUTCHINSON (1967)

Index	Calculation	Oligotrophic	Eutrophic
Myxophycean	$\frac{\text{Myxophyceae}}{\text{Desmideae}}$	0.0-0.4	0.1-3.0
Chlorophycean	$\frac{\text{Chlorococcales}}{}$	0.0-0.7	0.2-9.0
Diatom	$\frac{\text{Centric Diatoms}}{\text{Pennate Diatoms}}$	0.0-0.3	0.0-1.75
Euglenophyte	$\frac{\text{Euglenophyta}}{\text{Myxophyceae + Chlorococcales}}$	0.0-0.2	0.0-1.0
Compound	$\frac{\text{Myxophyceae + Chlorococcales + Centric Diatoms + Euglenophyta}}{\text{Desmideae}}$	0.0-1.0	1.2-25

TABLE 3. ALGAL GENUS POLLUTION INDEX (Palmer 1969)

Genus	Pollution Index
Anacystis	1
Ankistrodesmus	2
Chlamydomonas	4
Chlorella	3
Closterium	1
Cyclotella	1
Euglena	5
Comphonema	1
Lepocinclis	1
Melosira	1
Micractinium	1
Navicula	3
Nitzschia	3
Oscillatoria	5
Pandorina	1
Phacus	2
Phormidium	1
Scenedesmus	4
Stigeoclonium	2
Synedra	2

TABLE 4. ALGAL SPECIES POLLUTION INDEX (Palmer 1969)

Species	Pollution Index
Ankistrodesmus falcatus	3
Arthrospira jenneri	2
Chlorella vulgaris	2
Cyclotella meneghiniana	2
Euglena gracilis	1
Euglena viridis	6
Gomphonema parvulum	1
Melosira varians	2
Navicula cryptocephala	1
Nitzschia acicularis	1
Nitzschia palea	5
Oscillatoria chlorina	2
Oscillatoria limosa	4
Oscillatoria princeps	1
Oscillatoria putrida	1
Oscillatoria tenuis	4
Pandorina morum	3
Scenedesmus quadricauda	4
Stigeoclonium tenue	3
Synedra ulna	3

In analyzing a water sample, any of the 20 genera or species of algae present in concentrations of 50 per milliliter or more are recorded. The pollution index numbers of the algae present are totaled, providing a genus score and a species score. Palmer determined that a score of 20 or more for either index can be taken as evidence of high organic pollution, while a score of 15 to 19 is taken as probable evidence of high organic pollution. Lower figures suggest that the organic pollution of the sample is not high, that the sample is not representative, or that some substance or factor interfering with algal persistence is present and active.

SPECIES DIVERSITY AND ABUNDANCE INDICES

"Information content" of biological samples is being used commonly by biologists as a measure of diversity. Diversity in this connection means the degree of uncertainty attached to the specific identity of any randomly selected individual. The greater the number of taxa and the more equal their proportions, the greater the uncertainty, and hence, the diversity (Pielou 1966). There are several methods of measuring diversity, e.g., the formulas given by Brillouin (1962) and Shannon and Weaver (1963). The method which is appropriate depends on the type of biological sample on hand.

Pielou (1966) classifies the types of biological samples and gives the measure of diversity appropriate for each type. The Survey phytoplankton samples are what she classifies as larger samples (collections in Pielou's terminology) from which random subsamples can be drawn. According to Pielou, the average diversity per individual for these types of samples can be estimated from the Shannon-Wiener formula (Shannon and Weaver 1963):

$$H = -\sum_{i=1}^{S} P_i \log_x P_i$$

Where P is the proportion of the ith taxon in the sample, which is calculated from n_i/N; n_i is the number of individuals per milliliter of the ith taxon; N is the total number of individuals per ml; and S is the total number of taxa.

However, Basharin (1959) and Pielou (1966) have pointed out that H calculated from the subsample is a biased estimator of the sample H, and if this bias is to be accounted for, we must know the total number of taxa present in the sample since the magnitude of this bias depends on it.

Pielou (1966) suggests that if the number of taxa in the subsample falls only slightly short of the number in the larger sample, no appreciable error will result in considering S, estimated

from the subsample, as being equal to the sample value. Even though considerable effort was made to find and identify all taxa, the Survey samples undoubtedly contain a fair number of rare phytoplankton taxa which were not encountered.

In the Shannon-Wiener formula, an increase in the number of taxa and/or an increase in the evenness of the distribution of individuals among taxa will increase the average diversity per individual from its minimal value of zero. Sager and Hasler (1969) found that the richness of taxa was of minor importance in determination of average diversity per individual for phytoplankton and they concluded that phytoplankton taxa in excess of the 10 to 15 most abundant ones have little effect on H, which was verified by our own calculations. Our counts are in number per milliliter and since logarithms to the base 2 were used in our calculations, H is expressed in units of bits per individual. When individuals of a taxon were so rare that they were not counted, a value of 1/130 per milliliter or 0.008 per milliliter was used in the calculations since at least one individual of the taxon must have been present in the collection.

A Survey sample for a given lake represents a composite of all phytoplankton collected at different sampling sites on a lake during a given sampling period. Since the number of samples (M) making up a composite is a function of both the complexity of the lake sampled and its size, it should affect the richness-of-taxa component of the diversity of our phytoplankton collections. The maximum diversity (MaxH) (i.e., when the individuals are distributed among the taxa as evenly as possible) was estimated from $\log_2 S$, the total diversity (D) was calculated from HN, and the evenness component of diversity (J) was estimated from H/MaxH (Pielou 1966). Also given in the Appendix are L (the mean number of individuals per taxa per milliliter) and K (the number of individuals per milliliter of the most abundant taxon in the sample).

Zand (1976) suggests that diversity indices be expressed in units of "sits", i.e., in logarithms to base S (where S is the total number of taxa in the sample) instead of in "bits", i.e., in logarithms to base 2. Zand points out that the diversity index in sits per individual is a normalized number ranging from 1 for the most evenly distributed samples to 0 for the least evenly distributed samples. Also, it can be used to compare different samples, independent of the number of taxa in each. The diversity in bits per individual should not be used in direct comparisons involving various samples which have different numbers of species. Since MaxH equals log S, the expression in sits is equal to $\log_S S$, or 1. Therefore diversity in sits per individual is numerically equivalent to J, the evenness component for the Shannon-Wiener formula.

SPECIES OCCURRENCE AND ABUNDANCE

The alphabetic phytoplankton species list for each lake, presented in the Appendix, gives the concentrations of individual species by sampling date. Concentrations are in cells, colonies, or filaments (CEL, COL, FIL) per milliliter. An "X" after a species name indicates the presence of the species on that date in such a low concentration that it did not show up in the count. A blank space indicates that the organism was not found in the sample collected on that date. Column S is used to designate the examiner's subjective opinion of the five dominant taxa in a sample, based upon relative size and concentration of the organism. The percent column (%C) presents, by abundance, the percentage composition of each taxon.

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APPENDIX. SUMMARY OF PHYTOPLANKTON DATA

This appendix was generated by computer. Because it was only possible to use upper case letters in the printout, all scientific names are printed in upper case and are not italicized.

The alphabetic phytoplankton lists include taxa without species names (e.g., EUNOTIA, EUNOTIA #1, EUNOTIA ?, FLAGELLATE, FLAGELLATES, MICROSYSTIS INCERTA ?, CHLOROPHYTAN COCCOID CELLED COLONY). When species determinations were not possible, symbols or descriptive phrases were used to separate taxa for enumeration purposes. Each name on a list, however, represents a unique species different from any other name on the same list, unless otherwise noted, for counting purposes.

Numbers were used to separate unidentified species of the same genus. A generic name listed alone is also a unique species. A question mark (?) is placed immediately after the portion of a name which was assigned with uncertainty. Numbered, questioned, or otherwise designated taxa were established on a lake-by-lake basis; therefore NAVICULA #2 from lake A cannot be compared to NAVICULA #2 from lake B. Pluralized categories (e.g., FLAGELLATES, CENTRIC DIATOMS, SPP.) were used for counting purposes when taxa could not be properly differentiated on the counting chamber.

LAKE NAME: ARKABUTLA RES.
STORET NUMBER: 2901

NYGAARD TROPHIC STATE INDICES

DATE	06 13 73	08 28 73	11 01 73
MYXOPHYCEAN	02/0 E	03/0 E	3.00 E
CHLOROPHYCEAN	01/0 E	02/0 E	1.00 E
EUGLENOPHYTE	1.33 E	1.20 E	1.25 E
DIATOM	02/0 E	5.00 E	3.00 E
COMPOUND	09/0 E	16/0 E	12.0 E

PALMER'S ORGANIC POLLUTION INDICES

DATE	06 13 73	08 28 73	11 01 73
GENUS	06	02	06
SPECIES	00	00	00

SPECIES DIVERSITY AND ABUNDANCE INDICES

DATE		06 13 73	08 28 73	11 01 73
AVERAGE DIVERSITY	H	2.92	2.46	3.27
NUMBER OF TAXA	S	16.00	24.00	17.00
NUMBER OF SAMPLES COMPOSITED	M	3.00	3.00	3.00
MAXIMUM DIVERSITY	MAXH	4.00	4.59	4.09
TOTAL DIVERSITY	D	2538.00	2988.90	1988.16
TOTAL NUMBER OF INDIVIDUALS/ML	N	900.00	1215.00	608.00
EVENESS COMPONENT	J	0.71	0.54	0.80
MEAN NUMBER OF INDIVIDUALS/TAXA	L	56.25	50.63	35.76
NUMBER/ML OF MOST ABUNDANT TAXON	K	232.00	633.00	152.00

LAKE NAME: ARKABUTLA RES.
STORET NUMBER: 2801

CONTINUED

TAXA	FORM	06 13 73 S	06 13 73 %C	06 13 73 ALGAL UNITS PER ML	08 28 73 S	08 28 73 %C	08 28 73 ALGAL UNITS PER ML	11 01 73 S	11 01 73 %C	11 01 73 ALGAL UNITS PER ML
ANABAENA	FIL	2	3.2	29					11.0	67
CENTRIC DIATOM	CEL								2.8	17
CLOSTERIUM #1	CEL							2	13.8	84
CRYPTOMONAS	CEL		6.4	58						
CRYPTOMONAS EROSA	CEL			X						
CRYPTOMONAS REFLEXA	CEL				3	6.3	76			
CYANOPHYTAN FILAMENT	FIL	1	25.8	232						
CYCLOTELLA MENEGHINIANA	CEL						X			
CYCLOTELLA SPP.	CEL					6.3	76			
CYCLOTELLA STELLIGERA	CEL						X			
CYMBELLA	CEL									X
DACTYLOCOCCOPSIS	CEL						X			
DACTYLOCOCCOPSIS IRREGULARIS	FIL							5	25.0	152
EUGLENA #1	CEL	3	12.9	116			X			X
EUGLENA ACUS	CEL			X			X			
EUGLENA GRACILIS	CEL								2.8	17
FLAGELLATE #1	CEL	5	11.3	102		6.3	76			
FLAGELLATE #9	CEL			X						
GLENODINIUM OCULATUM	CEL						X			
GYMNODINIUM ?	CEL			X						
GYMNODINIUM ORDINATUM	CEL		3.2	29	5	6.3	76		2.8	17
LYNGBYA	FIL					2.1	25			
MALLOMONAS ACARCICES	CEL							1	13.8	84
MELOSIRA DISTANS	CEL		6.4	58			X	4	5.6	34
MELOSIRA GRANULATA	CEL	4	24.2	218	1	52.1	633	3	5.6	34
MELOSIRA GRANULATA V. ANGUSTISSIMA	CEL				4	6.3	76			
MICROCYSTIS INCERTA	COL								2.8	17
OSCILLATORIA LIMNETICA	FIL						X		8.4	51
PENNATE DIATOM	CEL						X			
PHACUS CAUDATUS	CEL						X			X
PHACUS DENNISII ?	CEL						X			

LAKE NAME: ARKABUTLA RES. CONTINUED
STORET NUMBER: 2801

TAXA	FORM	06 13 73 S	%C	ALGAL UNITS PER ML	08 28 73 S	%C	ALGAL UNITS PER ML	11 01 73 S	%C	ALGAL UNITS PER ML
PTERCMONAS	CEL			X			X			
PTERCMONAS ANGULCSA	CEL					4.2	51			
SCENEDESMUS DENTICULATUS	COL						X			
SCENEDESMUS QUACRICAUDA	CCL								2.8	17
TETRAEDRCN MINIMUM V. SCROBICULATUM	CEL			X						
TRACHELOMONAS PULCHELLA	CEL		6.4	58	2	8.3	101		2.8	17
TRACHELCMONAS URCEOLATA	CEL					2.1	25			
TRACHELOMONAS VOLVOCINA	CEL			X						X
TREUBARIA TRIAPPENDICULATA	CEL						X			
TOTAL				900			1215			608

LAKE NAME: ENID LAKE
STORET NUMBER: 2802

NYGAARD TROPHIC STATE INDICES

DATE	06 12 73	08 27 73	11 01 73
MYXOPHYCEAN	3.00 E	1.00 E	04/0 E
CHLOROPHYCEAN	1.00 E	1.67 E	03/0 E
EUGLENOPHYTE	0.50 E	1.37 E	0.43 E
DIATOM	4.00 E	0.50 E	0.50 E
COMPOUND	10.0 E	7.33 E	13/0 E

PALMER'S ORGANIC POLLUTION INDICES

DATE	06 12 73	08 27 73	11 01 73
GENUS	01	04	02
SPECIES	00	02	00

SPECIES DIVERSITY AND ABUNDANCE INDICES

DATE		06 12 73	08 27 73	11 01 73
AVERAGE DIVERSITY	H	3.14	2.79	2.29
NUMBER OF TAXA	S	16.00	37.00	23.00
NUMBER OF SAMPLES COMPOSITED	M	3.00	3.00	3.00
MAXIMUM DIVERSITY	MAXH	4.00	5.21	4.52
TOTAL DIVERSITY	D	1466.38	6439.32	5018.28
TOTAL NUMBER OF INDIVIDUALS/ML	N	467.00	2308.00	2201.00
EVENESS COMPONENT	J	0.79	0.54	0.50
MEAN NUMBER OF INDIVIDUALS/TAXA	L	29.19	62.38	95.70
NUMBER/ML OF MOST ABUNDANT TAXON	K	116.00	1124.00	1024.00

LAKE NAME: ENID LAKE
STORET NUMBER: 2802

CONTINUED

TAXA	FORM	06 12 73 S	06 12 73 %C	06 12 73 ALGAL UNITS PER ML	08 27 73 S	08 27 73 %C	08 27 73 ALGAL UNITS PER ML	11 01 73 S	11 01 73 %C	11 01 73 ALGAL UNITS PER ML
ANABAENA	FIL			X						
ANKISTRODESMUS	CEL					2.0	46			X
APHANIZOMENON ? FLOS-AQUAE	FIL	3	13.9	55						
APHANIZOMENON FLOS-AQUAE	FIL				1	13.8	319		2.3	51
CLOSTERIUM	CEL			X		0.6	15			
COELASTRUM MICROPORUM	COL	4	5.6	26						
CRUCIGENIA TETRAPEDIA	COL						X			
CRYPTOMONAS	CEL								1.2	26
CRYPTOMONAS OVATA	CEL		5.6	26	2	9.2	213			
CRYPTOMONAS REFLEXA	CEL					1.3	30			
CYCLOTELLA MENEGHINIANA	CEL					3.3	76			
CYCLOTELLA STELLIGERA	CEL	5	8.4	39				3	8.1	179
CYMBELLA	CEL						X			
CYST	CEL									X
DACTYLOCOCCOPSIS IRREGULARIS	CEL								4.6	102
EUASTRUM DENTICULATUM	CEL						X			
EUDORINA ELEGANS	CEL			X						
EUGLENA ? #2	CEL						X			
EUGLENA #1	CEL			X		0.6	15			
EUGLENA #3	CEL									X
EUGLENA #4	CEL						X			
EUGLENA ACUS	CEL						X			
FLAGELLATE #1	CEL		8.4	39						
LYNGBYA	FIL				3	48.7	1124			
MALLOMONAS ACAROIDES	CEL							5	2.3	51
MELOSIRA DISTANS	CEL	2	16.7	78		3.9	91	2	46.5	1024
MELOSIRA GRANULATA	CEL			X				1	19.8	435
MELOSIRA ITALICA	CEL	1	24.8	116	4	3.3	76			
MERISMOPEDIA TENUISSIMA	COL					0.6	15			
MICROCYSTIS INCERTA	COL								1.2	26
NAVICULA #1	CEL						X			
NAVICULA ANGLICA V. SUBSALSA	CEL									X

LAKE NAME: ENID LAKE
STORET NUMBER: 2802

CONTINUED

TAXA	FORM	06 12 73 S	06 12 73 %C	06 12 73 ALGAL UNITS PER ML	08 27 73 S	08 27 73 %C	08 27 73 ALGAL UNITS PER ML	11 01 73 S	11 01 73 %C	11 01 73 ALGAL UNITS PER ML
NITZSCHIA	CEL					0.6	15			
NITZSCHIA #1	CEL									X
NITZSCHIA TRYBLIONELLA ?	CEL									X
OPHIOCYTIUM CAPITATUM	CEL					0.6	15			
OSCILLATORIA LIMNETICA	FIL		2.8	13						X
PANDORINA PROTUBERANS	COL						X			
PEDIASTRUM DUPLEX V. GRACILIMUM	COL									X
PEDIASTRUM DUPLEX V. RETICULATUM	COL					0.6	15			
PENNATE DIATOMS	CEL							4	13.9	307
PERIDINIUM INCONSPICUUM	CEL					2.0	46			
PERIDINIUM PENARDIFORME	CEL						X			X
PHACUS	CEL						X			
PHACUS GLABER	CEL						X			
PHACUS LONGICAUDA	CEL						X			
PHACUS PLEURONECTES	CEL									X
PINNULARIA BRAUNII V. AMPHICEPHALA	CEL									X
PINNULARIA SUBCAPITATA V. PAUCISTRIATA	CEL									X
PTEROMONAS ANGULOSA	CEL									X
SCENEDESMUS DENTICULATUS	CEL		2.8	13						X
SCENEDESMUS QUADRICAUDA	COL						X			
STAURASTRUM TETRACERUM	COL					0.6	15			
SURIRELLA	CEL						X			
SYNEDRA	CEL		5.6	26						
SYNEDRA #1	CEL					2.6	61			
SYNEDRA ACUS	CEL				5	3.3	76			
TETRAEDRON REGULARE V. INCUS	CEL						X			
TRACHELOMONAS	CEL						X			X

LAKE NAME: ENID LAKE
STORET NUMBER: 2802

CONTINUED

TAXA	FORM	06 12 73 S	%C	ALGAL UNITS PER ML	08 27 73 S	%C	ALGAL UNITS PER ML	11 01 73 S	%C	ALGAL UNITS PER ML
TRACHELOMONAS INTERMEDIA ?	CEL					1.3	30			
TRACHELOMONAS PULCHELLA	CEL		5.6	26						
TRACHELOMONAS URCEOLATA	CEL					0.6	15			
TRACHELOMONAS VOLVOCINA	CEL						X			
TOTAL				467			2308			2201

LAKE NAME: ROSS BARNETT RES.
STORET NUMBER: 2804

NYGAARD TROPHIC STATE INDICES

DATE	06 14 73	08 27 73	11 02 73
MYXOPHYCEAN	06/0 E	4.00 E	2.25 E
CHLOROPHYCEAN	07/0 E	3.50 E	3.75 E
EUGLENOPHYTE	0.38 E	0.33 E	0.12 ?
DIATOM	6.00 E	0.60 E	0.50 E
COMPOUND	24/0 E	11.5 E	7.75 E

PALMER'S ORGANIC POLLUTION INDICES

DATE	06 14 73	08 27 73	11 02 73
GENUS	01	07	22
SPECIES	00	00	04

SPECIES DIVERSITY AND ABUNDANCE INDICES

DATE		06 14 73	08 27 73	11 02 73
AVERAGE DIVERSITY	H	2.21	2.42	4.13
NUMBER OF TAXA	S	32.00	36.00	54.00
NUMBER OF SAMPLES COMPOSITED	M	4.00	4.00	4.00
MAXIMUM DIVERSITY	MAXH	5.00	5.17	5.75
TOTAL DIVERSITY	D	2934.88	14435.30	33147.30
TOTAL NUMBER OF INDIVIDUALS/ML	N	1328.00	5965.00	8026.00
EVENESS COMPONENT	J	0.44	0.47	0.72
MEAN NUMBER OF INDIVIDUALS/TAXA	L	41.50	165.69	148.63
NUMBER/ML OF MOST ABUNDANT TAXON	K	865.00	2419.00	1569.00

LAKE NAME: ROSS BARNETT RES.
STORET NUMBER: 2804

CONTINUED

TAXA	FORM	06 14 73 S	06 14 73 %C	06 14 73 ALGAL UNITS PER ML	08 27 73 S	08 27 73 %C	08 27 73 ALGAL UNITS PER ML	11 02 73 S	11 02 73 %C	11 02 73 ALGAL UNITS PER ML
ANABAENA	FIL						X	1	3.0	244
ANABAENA ? #2	FIL		1.4	18						
ANABAENA #1	FIL			X						
ANABAENOPSIS	FIL					3.3	194			
ANKISTRODESMUS	CEL		1.4	18						
ANKISTRODESMUS ?	CEL					0.3	16			
APHANIZOMENON FLOS-AQUAE	FIL		1.4	18		0.3	16			
ATTHEYA	CEL		1.4	18						X
CHLAMYDOMONAS	CEL								0.6	51
CHLOROGONIUM	CEL									X
CHLOROPHYTAN COCCOID CELL	CEL						X			
COELASTRUM MICROPORUM	COL	5	1.4	18						
COELASTRUM RETICULATUM	COL									X
COSMARIUM	CEL					0.5	32		0.3	26
CRUCIGENIA FENESTRATA	COL								0.5	39
CRUCIGENIA TETRAPEDIA	COL								0.6	51
CRYPTOMONAS	CEL					0.5	32			
CRYPTOMONAS EROSA	CEL							2	3.5	283
CRYPTOMONAS EROSA V. REFLEXA	CEL									X
CRYPTOMONAS OVATA	CEL	3	4.0	53						
CRYPTOMONAS REFLEXA ?	CEL			X						
CYCLOTELLA MENEGHINIANA	CEL									X
CYCLOTELLA SPP.	CEL								5.3	424
CYCLOTELLA STELLIGERA	CEL				4	3.3	194			
CYMBELLA	CEL									X
DACTYLOCOCCOPSIS	CEL							4	19.5	1565
DINOBRYON BAVARICUM	CEL								2.1	167
EPITHEMIA	CEL									X
EUASTRUM	CEL						X		0.3	26
EUGLENA	CEL								0.2	13
EUGLENA #1	CEL			X			X			

LAKE NAME: ROSS BARNETT RES. CONTINUED
STORET NUMBER: 2804

TAXA	FORM	06 14 73 S	06 14 73 %C	06 14 73 ALGAL UNITS PER ML	08 27 73 S	08 27 73 %C	08 27 73 ALGAL UNITS PER ML	11 02 73 S	11 02 73 %C	11 02 73 ALGAL UNITS PER ML
EUGLENA #2	CEL					0.8	48			
EUGLENA GRACILIS	CEL						X			
FLAGELLATE #1	CEL		4.0	53					9.0	720
FLAGELLATE #7	CEL		1.4	18						
FRANCEIA DROESCHERI	CEL						X			
FRANCEIA QUADRISETA	CEL								0.3	26
GLENODINIUM OCULATUM	CEL						X			
GOLENKINIA	CEL								0.5	39
GOLENKINIA RADIATA	CEL					0.3	16			
GOMPHONEMA ANGUSTATUM	CEL						X			
GYMNODINIUM	CEL								0.3	26
GYMNODINIUM ORDINATUM	CEL					0.8	48			
GYROSIGMA ?	CEL						X			
KIRCHNERIELLA	CEL							3	7.1	566
KIRCHNERIELLA CONTORTA	CEL						X			
LYNGBYA	FIL								4.0	322
LYNGBYA LIMNETICA	FIL					6.8	403			
MALLOMONAS	CEL								0.2	13
MALLOMONAS ACAROIDES	CEL				3	3.5	210			X
MELOSIRA	CEL			X						
MELOSIRA DISTANS	CEL		5.3	71		0.3	16	5	12.0	965
MELOSIRA GRANULATA	CEL	1	65.1	865					1.9	154
MELOSIRA GRANULATA V. ANGUSTISSIMA	CEL			X						
MELOSIRA ITALICA	CEL				5	2.4	145			
MERISMOPEDIA TENUISSIMA	COL			X		0.3	16		4.8	386
MICROCYSTIS	COL									X
MICROCYSTIS AERUGINOSA	COL			X						
MICROCYSTIS INCERTA	COL						X		9.1	733
NAVICULA	CEL								1.9	154
NAVICULA #1	CEL						X			
NAVICULA #2	CEL						X			

LAKE NAME: ROSS BARNETT RES.
STORET NUMBER: 2804

CONTINUED

TAXA	FORM	06 14 73 S	06 14 73 %C	06 14 73 ALGAL UNITS PER ML	08 27 73 S	08 27 73 %C	08 27 73 ALGAL UNITS PER ML	11 02 73 S	11 02 73 %C	11 02 73 ALGAL UNITS PER ML
NITZSCHIA	CEL			X						
NITZSCHIA ACICULARIS	CEL									X
NITZSCHIA HOLSATICA	CEL					0.5	32			X
NITZSCHIA PALEA	CEL									X
NITZSCHIA SPP.	CEL								3.2	257
OSCILLATORIA	FIL								1.0	77
OSCILLATORIA LIMNETICA	FIL		1.4	18	1	40.6	2419			
PANDORINA PROTUBERANS	COL		1.4	18						
PEDIASTRUM	COL								0.3	26
PEDIASTRUM DUPLEX V. CLATHRATUM	COL									X
PEDIASTRUM DUPLEX V. RETICULATUM	COL			X		0.3	16			
PERIDINIUM INCONSPICUUM	CEL		1.4	18		0.5	32		0.2	13
PHACUS CURVICAUDA	CEL			X			X			
RAPHIDIOPSIS ? CURVATA	FIL				2	34.1	2032			
SCENEDESMUS ABUNDANS	COL		2.6	35					0.6	51
SCENEDESMUS BICALDATUS	COL								1.8	142
SCENEDESMUS BIJUGA	COL			X		0.3	16		1.0	77
SCENEDESMUS DENTICULATUS	COL								0.3	26
SCENEDESMUS DIMORPHUS	COL								1.9	154
SCENEDESMUS QUADRICAUDA	COL			X			X			
SPHAEROCYSTIS SCHROETERI	COL			X					0.2	13
SPIRULINA	FIL									X
STAURASTRUM #1	CEL								0.6	51
STAURASTRUM #2	CEL									
STEPHANODISCUS	CEL	2	5.3	71						X
SURIRELLA	CEL								0.2	13
SYNEDRA	CEL									
SYNURA ?	CEL			X						
TETRAEDRON CAUDATUM V. LONGISPINUM	CEL								0.6	51

LAKE NAME: ROSS BARNETT RES. CONTINUED
STORET NUMBER: 2904

TAXA	FORM	06 14 73 S	06 14 73 %C	06 14 73 ALGAL UNITS PER ML	08 27 73 S	08 27 73 %C	08 27 73 ALGAL UNITS PER ML	11 02 73 S	11 02 73 %C	11 02 73 ALGAL UNITS PER ML
TETRAEDRON MUTICUM	CEL								0.3	26
TRACHELOMONAS	CEL					0.5	32			
TRACHELOMONAS INTERMEDIA	CEL			X						
TRACHELOMONAS PULCHELLA	CEL								0.3	26
TRACHELOMONAS URCEOLATA	CEL	4	1.4	18						
TRACHELOMONAS VOLVOCINA	CEL			X					0.3	26
TOTAL				1328			5965			8026

LAKE NAME: SARDIS LAKE
STORET NUMBER: 2805

NYGAARD TROPHIC STATE INDICES

DATE	06 13 73	08 27 73	11 01 73
MYXOPHYCEAN	02/0 E	2.00 E	2.50 E
CHLOROPHYCEAN	01/0 E	0/01 C	1.50 E
EUGLENOPHYTE	0.33 E	1.50 E	0.25 E
DIATOM	1.33 E	3.00 E	1.25 E
COMPOUND	08/0 E	8.00 E	7.50 E

PALMER'S ORGANIC POLLUTION INDICES

DATE	06 13 73	08 27 73	11 01 73
GENUS	01	01	04
SPECIES	00	00	00

SPECIES DIVERSITY AND ABUNDANCE INDICES

DATE		06 13 73	08 27 73	11 01 73
AVERAGE DIVERSITY	H	1.05	1.33	1.79
NUMBER OF TAXA	S	16.00	15.00	29.00
NUMBER OF SAMPLES COMPOSITED	M	4.00	4.00	4.00
MAXIMUM DIVERSITY	MAXH	4.00	3.91	4.86
TOTAL DIVERSITY	D	3535.35	2276.96	4390.87
TOTAL NUMBER OF INDIVIDUALS/ML	N	3367.00	1712.00	2453.00
EVENESS COMPONENT	J	0.26	0.34	0.37
MEAN NUMBER OF INDIVIDUALS/TAXA	L	210.44	114.13	84.59
NUMBER/ML OF MOST ABUNDANT TAXON	K	2782.00	1289.00	1699.00

LAKE NAME: SARDIS LAKE
STORET NUMBER: 2905

CONTINUED

TAXA	FORM	05 13 73 S	05 13 73 %C	05 13 73 ALGAL UNITS PER ML	08 27 73 S	08 27 73 %C	08 27 73 ALGAL UNITS PER ML	11 01 73 S	11 01 73 %C	11 01 73 ALGAL UNITS PER ML
ANABAENA	FIL									X
ANABAENA PLANCTONICA	FIL			X						
ANKISTRODESMUS FALCATUS	CEL									X
CENTRIC DIATOM	CEL						X			
CERATIUM HIRUNDINELLA	CEL									X
CHLOROPHYTAN COLONY	COL			X						
CLOSTERIUM	CEL						X			X
CRYPTOMONAS	CEL		0.9	29	3	5.9	101	3	4.9	120
CRYPTOMONAS #1	CEL									X
CRYPTOMONAS REFLEXA	CEL				4	4.7	81			X
CYANOPHYTAN COCCOID CELLED COLONY	CEL									X
CYANOPHYTAN FILAMENT	FIL			X					0.7	17
CYCLOTELLA STELLIGERA	CEL								6.3	154
CYMBELLA	CEL		0.4	15						
DIACBRYON BAVARICUM	CEL								0.7	17
EUASTRUM	CEL									X
EUGLENA	CEL			X				5	0.7	17
EUGLENA #1	CEL									X
FLAGELLATE #1	CEL	2	6.1	205						
FLAGELLATE #2	CEL			X						X
FLAGELLATE #9	CEL			X						
FLAGELLATES	CEL							2	69.3	1699
LAGERHEIMIA	CEL									X
LEPOCINCLIS	CEL						X			
LYNGBYA LIMNETICA ?	FIL				1	75.3	1289			X
MALLOMONAS	CEL				5	2.3	40		1.4	34
MELOSIRA DISTANS	CEL	3	5.6	190			X	4	4.2	103
MELOSIRA GRANULATA	CEL				2	9.4	161	1	7.7	189
MELOSIRA GRANULATA V. ANGUSTISSIMA	CEL	4	2.6	88						
MELOSIRA ITALICA	CEL	1	82.6	2782						X
NAVICULA	CEL									X

LAKE NAME: SARDIS LAKE
STORET NUMBER: 2805

CONTINUED

TAXA	FORM	06 13 73 S	06 13 73 %C	06 13 73 ALGAL UNITS PER ML	08 27 73 S	08 27 73 %C	08 27 73 ALGAL UNITS PER ML	11 01 73 S	11 01 73 %C	11 01 73 ALGAL UNITS PER ML
OSCILLATORIA LIMNETICA	FIL						X			X
PEDIASTRUM DUPLEX V. RETICULATUM ?	COL									X
PENNATE DIATOMS	CEL								0.7	17
PERIDINIUM INCONSPICUUM	CEL						X			
PERIDINIUM UMBONATUM ?	CEL						X			
PHACUS ORBICULARIS ?	CEL						X			
RHIZOSOLENIA	CEL									X
SCHROEDERIA SETIGERA	CEL			X						
STEPHANODISCUS	CEL	5	1.3	43						
SYNEDRA	CEL		0.4	15		2.3	40		0.7	17
SYNEDRA #1	CEL								2.8	69
TABELLARIA FENESTRATA	CEL			X						
TRACHELOMONAS DUBIA ?	CEL						X			
TOTAL				3367			1712			2453

LAKE NAME: GRENADA LAKE
STORET NUMBER: 2806

NYGAARD TROPHIC STATE INDICES

DATE	06 14 73	08 28 73	11 02 73
MYXOPHYCEAN	02/0 E	5.00 E	06/0 E
CHLOROPHYCEAN	0/0 O	4.00 E	0/0 O
EUGLENOPHYTE	0/02 ?	0.56 E	0.93 E
DIATOM	1.50 E	2.50 E	2.00 E
COMPOUND	05/0 E	19.0 E	17/0 E

PALMER'S ORGANIC POLLUTION INDICES

DATE	06 14 73	08 28 73	11 02 73
GENUS	01	01	01
SPECIES	00	00	00

SPECIES DIVERSITY AND ABUNDANCE INDICES

DATE		06 14 73	08 28 73	11 02 73
AVERAGE DIVERSITY	H	1.95	2.77	1.52
NUMBER OF TAXA	S	9.00	28.00	27.00
NUMBER OF SAMPLES COMPOSITED	M	3.00	3.00	3.00
MAXIMUM DIVERSITY	MAXH	3.17	4.81	4.75
TOTAL DIVERSITY	D	2591.55	1282.51	3734.64
TOTAL NUMBER OF INDIVIDUALS/ML	N	1329.00	463.00	2457.00
EVENESS COMPONENT	J	0.62	0.58	0.32
MEAN NUMBER OF INDIVIDUALS/TAXA	L	147.67	16.54	91.00
NUMBER/ML OF MOST ABUNDANT TAXON	K	772.00	141.00	1796.00

LAKE NAME: GRENADA LAKE
STORET NUMBER: 2805

CONTINUED

TAXA	FORM	06 14 73 S	06 14 73 %C	06 14 73 ALGAL UNITS PER ML	08 28 73 S	08 28 73 %C	08 28 73 ALGAL UNITS PER ML	11 02 73 S	11 02 73 %C	11 02 73 ALGAL UNITS PER ML
ANABAENA #2	FIL	5	4.2	56		2.2	10	4	0.8	19
ANABAENA PLANCTONICA	FIL	1	15.9	211			X			X
ANKISTRODESMUS	CEL						X			
CRYPTOMONAS	CEL	3	0.9	12						X
CRYPTOMONAS OVATA	CEL				3	13.2	61	3	2.0	49
CYCLOTELLA MENEGHINIANA	CEL						X		0.4	10
CYCLOTELLA STELLIGERA	CEL					2.2	10		0.8	19
CYMBELLA	CEL			X			X			
DINOBRYON BAVARICUM	CEL						X			
DINOFLAGELLATE CYST	CEL									X
EUGLENA #1	CEL						X			
EUGLENA GRACILIS	CEL							5	0.8	19
EUGLENA OXYURIS	CEL									X
FLAGELLATE #1	CEL		11.4	152	2	26.1	121		0.8	19
GLENODINIUM OCULATUM ?	CEL						X			
GLENODINIUM PENARDIFORME	CEL								0.4	10
GYMNODINIUM ORDINATUM	CEL								0.4	10
KIRCHNERIELLA CONTORTA	COL					2.2	10			
LYNGBYA	FIL					4.3	20			
MALLOMONAS ACAROIDES	CEL									X
MELOSIRA	CEL									X
MELOSIRA #4	CEL								0.4	10
MELOSIRA DISTANS	CEL		3.5	47	1	30.5	141	2	15.8	388
MELOSIRA GRANULATA	CEL				4	6.5	30	1	73.1	1796
MELOSIRA GRANULATA V. ANGUSTISSIMA	CEL	4	4.2	56			X			
MELOSIRA ITALICA	CEL	2	58.1	772						
MERISMOPEDIA TENUISSIMA	COL				5	9.6	40		0.4	10
MICROCYSTIS AERUGINOSA	COL						X			X
NITZSCHIA ?	CEL								1.6	39
NITZSCHIA ACICULARIS	CEL						X			
OSCILLATORIA	FIL								0.4	10

LAKE NAME: GRENADA LAKE
STORET NUMBER: 2806

CONTINUED

TAXA	FORM	06 14 73 S	06 14 73 %C	06 14 73 ALGAL UNITS PER ML	08 28 73 S	08 28 73 %C	08 28 73 ALGAL UNITS PER ML	11 02 73 S	11 02 73 %C	11 02 73 ALGAL UNITS PER ML
OSCILLATORIA LIMOSA	FIL								0.4	10
PANDORINA MORUM	COL						X			
PENNATE DIATOM	CEL								0.8	19
PENNATE DIATOMS	CEL		1.7	23						
PHACUS CAUDATUS	CEL						X			
PHACUS SUECICUS ?	CEL						X			
PINNULARIA BRAUNII V. AMPHICEPHALA	CEL									X
PTEROMONAS	CEL					2.2	10			
SCENEDESMUS DENTICULATUS V. LINEARIS	COL						X			
SPHAEROCYSTIS SCHROETERI	COL						X			
STAURASTRUM LEPTOCLADUM	CEL						X			
TRACHELOMONAS INTERMEDIA ?	CEL						X			
TRACHELOMONAS PULCHELLA	CEL								0.4	10
TRACHELOMONAS URCEOLATA	CEL									X
TRACHELOMONAS VOLVOCINA	CEL					2.2	10		0.4	10
TOTAL				1329			463			2457

*U.S. GOVERNMENT PRINTING OFFICE: 1977 - 783-010/1010 Region No. 9-1